DRAFT

60135

Glass-coated, high-shocked Anorthosite

137.7 grams

Figure 1: Photo of 60315. Tick marks are 1 cm. NASA S72-37967.

Introduction

60135 is a glass covered, round object with a coarse-grained, highly shocked cumulate interior (figure 1). The glass coating on one side has been eroded off by micrometeorite bombardment, exposing the interior (figure 7). The glass composition is that of a soil and the interior rock is a ferroan anorthosite. It was found sitting perched on the regolith, but may have been kicked up.

Petrography

Warren et al. (1983) find the interior rock fragment is a "coarse grain cumulate – highly shocked but not brecciated". They conclude that it originated as a coarse cumulate, with subhedral cumulus plagioclase crystals up to 4.4 mm across, and anhedral, poikilitic, intercumulus pyroxene crystals in optical continuity up to 5 mm apart. Mineral analyses indicate it is a ferroan anorthosite (figure 4).

Mineralogy

Olivine: not reported

Pyroxene: Pyroxene is pigeonite (Wo_3En_{64}) typical of ferroan anorthosite (Warren et al. 1983). Exsolution lamalae are lacking, but may have been homogenized.

Mineralogical Mode of 60135

	Warren et al. 1983	
Plagioclase:	95 %	75
Pyroxene:	5	25

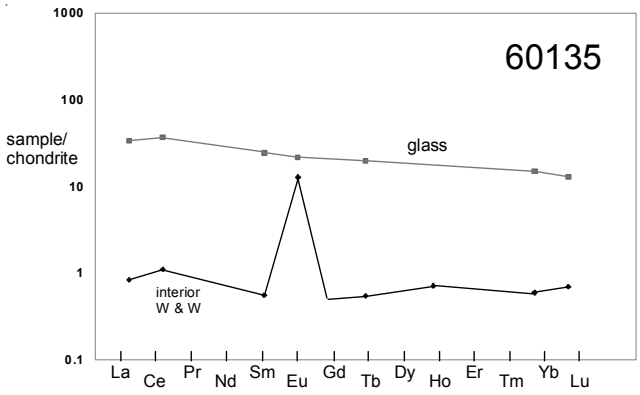


Figure 2: Normalized rare-earth-element diagram for 60135 showing that the glass coating was not made from the interior rocklet (data from Warren and Wasson 1983).

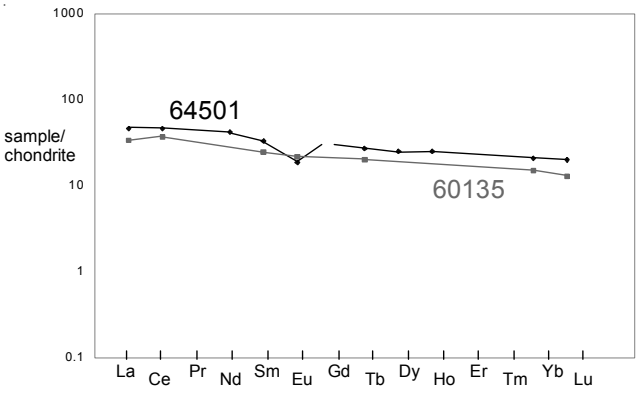


Figure 3: Normalized rare-earth-element pattern for glass on 60135 (Morris et al. 1983) compared with soil 64501 (Papike et al. 1982).

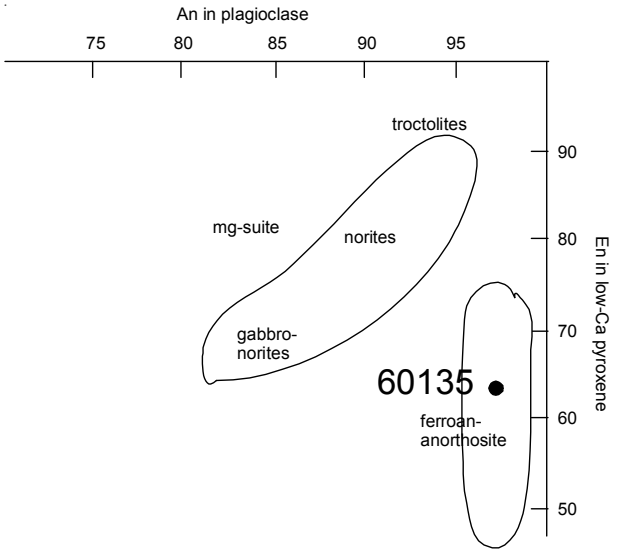


Figure 4: Plagioclase and pyroxene composition of interior of 60135 compared with known lunar rocks.

Plagioclase: Plagioclase is maskleynite with composition $An_{96\text{-}98}$ (Warren et al. 1983).

Ilmenite: not reported

Chemistry

Warren et al. (1983) found that the interior of this glass "egg" was highly aluminous as did See et al. (1986). Warren et al. analyzed two splits and found different results do to sampling error of such a coarse grained sample (average is given in table 1). See et al. (1986) and Morris et al. (1986) analyzed the glass and found it was rather like the soil and very unlike the interior (figures 2 and 3). Eldridge et al. (1973) analyzed the whole egg.

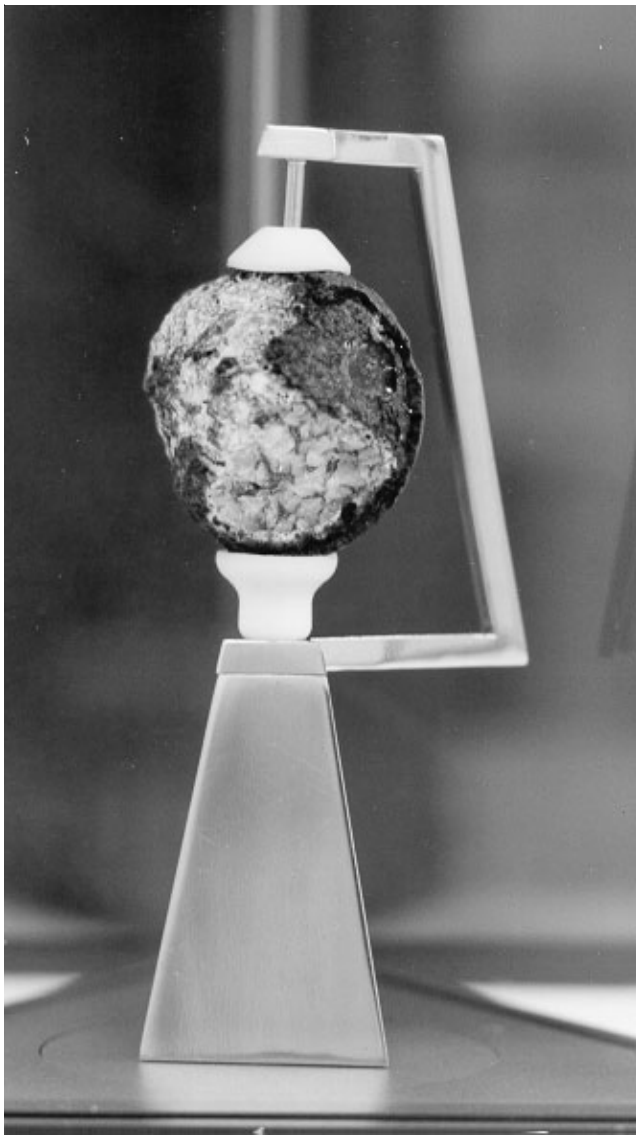
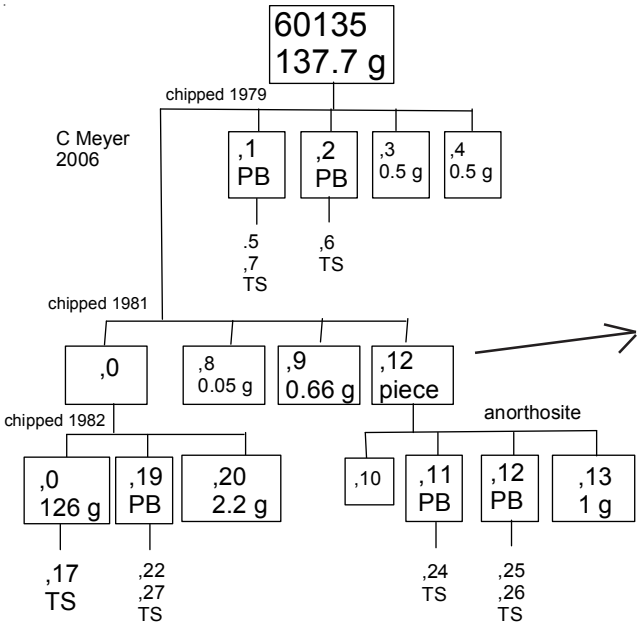


Figure 5: Lunar Sample 60135 on display. NASA S94-39619.

Table 1. Chemical composition of 60135.

									rock	
reference	Eldridge 73		See 86			Morris 86			Warren 83	
weight	bulk		glass	anor		glass			*(ave)*	
SiO2 %			43.69	43.91	(a)	43.69		(a)	44.9	
TiO2			0.17	0.02	(a)	0.17		(a)	0.006	
Al2O3			3.77	35.24	(a)	30.77		(a)	32.7	
FeO			3.55	0.55	(a)	4.77		(b)	2.3	
MnO									0.04	
MgO			3.82	0.5	(a)	3.82		(a)	2.8	
CaO			17.2	19.26	(a)	17.2		(a)	17.6	
Na2O			0.33	0.35	(a)	0.35		(b)	0.32	
K2O	0.018	(c)	0.05	0.04	(a)	0.05		(a)	0.004	
P2O5										
S %										
sum										
Sc ppm						5.21		(b)	4.6	
V										
Cr						706		(b)	399	
Co						43		(b)	4.8	
Ni						632		(b)	11	
Cu										
Zn									5	
Ga									3.1	
Ge ppb									93	(d)
As										
Se										
Rb										
Sr									157	
Y										
Zr									10	
Nb										
Mo										
Ru										
Rh										
Pd ppb										
Ag ppb										
Cd ppb									14	(d)
In ppb										
Sn ppb										
Sb ppb										
Te ppb										
Cs ppm										
Ba						87		(b)	9	
La						7.88		(b)	0.2	
Ce						22.4		(b)	0.67	
Pr										
Nd										
Sm						3.61		(b)	0.083	
Eu						1.21		(b)	0.72	
Gd										
Tb						0.72		(b)	0.02	
Dy										
Ho									0.04	
Er										
Tm										
Yb						2.39		(b)	0.098	
Lu						0.31		(b)	0.017	
Hf						2.3		(b)	0.06	
Ta						0.27		(b)	0.0057	
W ppb										
Re ppb									0.11	(d)
Os ppb										
Ir ppb									3.13	(d)
Pt ppb										
Au ppb									1.07	(d)
Th ppm	0.27	(c)				1.64		(b)	0.018	
U ppm	0.068	(c)				0.46		(b)		

technique: (a) emp, (b) INAA, (c) rad. Counting, (d) RNAA



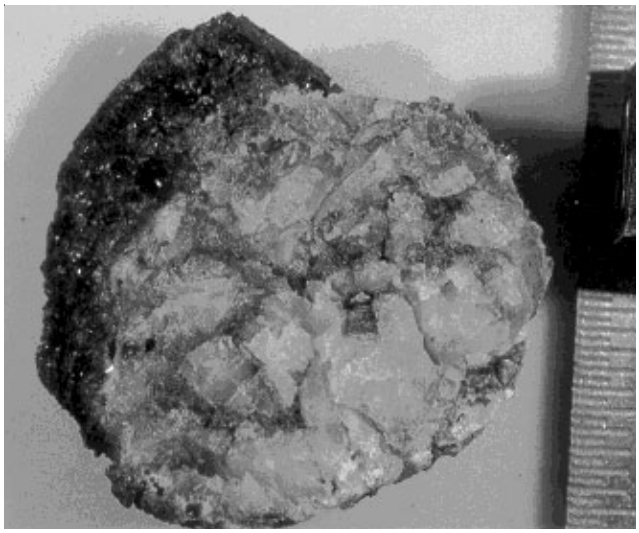


Figure 6: The piece (,12) that was chipped in 1981 (see diagram).

Cosmogenic isotopes and exposure ages

Eldridge et al. (1973) determined the cosmic-ray-induced activity of ^{22}Na = 40 dpm/kg. and ^{26}Al = 160 dpm/kg.

Processing

One end of this glass "egg" has been sampled carefully, several times, to preserve the majority of it (figures 6 and 7). It is now used as a display sample for very special occasions (figure 5).

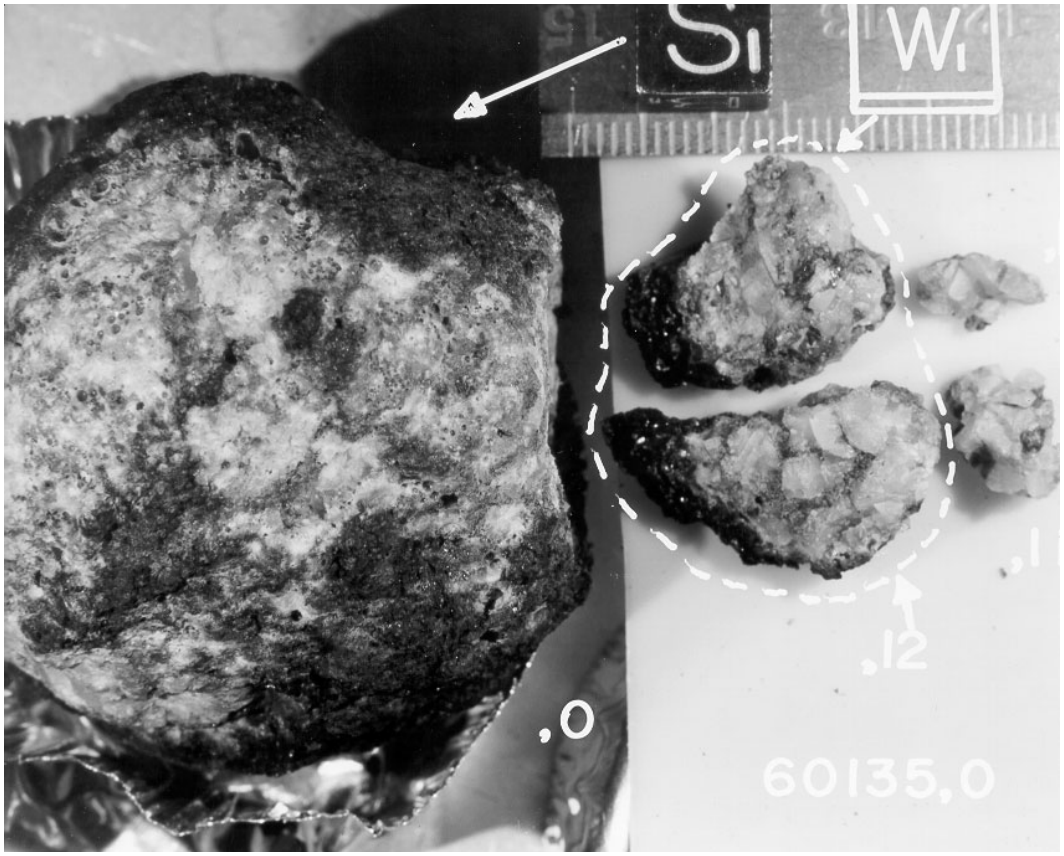


Figure 7: Chipping of 60135 in 1981. NASA S81-41552. Cube is 1 cm.